TAXONOMIC IMPLICATIONS OF BRANCHING PATTERNS IN THE DWARF MISTLETOES (*ARCEUTHOBIUM*)

Walter R. Mark
Natural Resources Management Department
California Polytechnic State University
San Luis Obispo, Calif. 93407

and

Frank G. Hawksworth
USDA Forest Service
Rocky Mountain Forest and Range Experiment Station[1]
Fort Collins, Colo. 80526

Abstract

The genus *Arceuthobium* has been separated into two subgenera based primarily on branching patterns: verticillate in subgenus *Arceuthobium* and flabellate in subgenus *Vaginatum*. This study of two California members of subgenus *Vaginatum* (*A. occidentale* and *A. campylopodum*) showed that they exhibited limited (average less than 5%) verticillate branching in addition to the predominate flabellate type. Presence of flabellate branching, rather than absence of verticillate branching is thus a better criterion for distinguishing subgenus *Vaginatum*. Subgenus *Arceuthobium* seems to be exclusively verticillate.

Secondary branching pattern has been considered to be of major taxonomic importance in separating subgeneric groupings of dwarf mistletoe, *Arceuthobium* (Hawksworth and Wiens 1970, 1972; Kuijt 1970). There are two basic types of secondary branching: verticillate and flabellate (fig. 1). Species with flabellate branching occur only in the New World, but verticillate branching is exhibited by all Old World species and a few in the New World. Hawksworth and Wiens (1970) used branching patterns as the primary basis for designation of subgenera. Species with flabellate branching were placed in subgenus *Vaginata*, and those with verticillate branching in subgenus *Arceuthobium*.

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[1]Headquarters is in Fort Collins, in cooperation with Colorado State University.

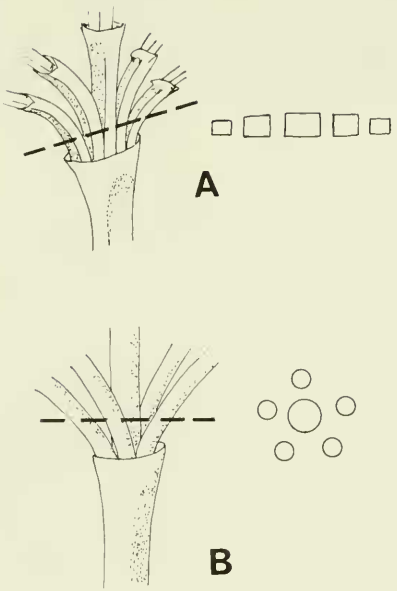

Figure 1.--Shoots of dwarf mistletoe: A, typical flabellate branching pattern with cross section through dashed area; B, typical verticillate or whorled type of branching with cross section through dashed area. All taxa show decussate primary branching, but in most cases the secondary type of branching also develops which may be either flabellate or verticillate (Hawksworth and Wiens 1972).

Recently we noticed that *Arceuthobium occidentale* Engelm. (subgenus *Vaginata*), parasitic on *Pinus radiata* at Cambria, California, exhibited some verticillate branching in addition to the predominately flabellate branching. These observations prompted a detailed examination of *A. occidentale* and the closely related species *A. campylopodum* Engelm., in California.

Thirty populations of *A. occidentale*, from 6 pine hosts, and 33 populations of *A. campylopodum*, from 6 pines, were sampled throughout California (Table 1). For each population, 50 shoots with secondary branching (25 of each sex) were examined and the proportion showing verticillate branching determined.

The results (Table 1) show some verticillate branching in all but 1 of the 63 populations sampled. Verticillate branching was quite variable among the populations studied: from none to 18% for *A. campylopodum* and from none to 10% for *A. occidentale*. In some populations, verticillate branching was common in plants of one sex but absent in the other. For all populations, 4% of the *A. campylopodum* shoots and 5% of the *A. occidentale* shoots showed some verticillate branching. Verticillate branching was about twice as common in staminate as in pistillate shoots for both species.

The results show that these two members of the subgenus *Vaginatum* exhibit verticillate branching in addition to the predominate flabellate type. In addition, rare verticillate branching has been observed in other members, in the subgenus *Vaginatum* (*A. vaginatum* subsp. *cryptopodum* (Engelm.) Hawksw. & Wiens, and in *A. cyanocarpum* Coult. & Nels.), in Colorado.

From a taxonomic standpoint, branching pattern is still a valid character for separating the two subgenera of *Arceuthobium*. However, the presence of flabellate branching, rather than the absence of verticillate branching, is a better criterion for distinguishing subgenus *Vaginatum*. Subgenus *Arceuthobium* seems to be exclusively verticillate. From a phytogenetic standpoint, subgenus *Vaginatum* seems to be derived from a basically verticillate (Old World) stock and, while predominately flabellate, exhibits a limited amount of residual verticillate branching.

Table 1. Proportion of shoot exhibiting verticillate branching. Based on 50 shoots in each population.

Dwarf mistletoe and host	Number of populations examined	Pistillate Plants % shoots with verticillate branching	Staminate Plants % shoots with verticillate branching
Arceuthobium campylopodum			
Pinus ponderosa	16	2.6	3.7
Pinus jeffreyi	11	2.8	7.3
Pinus coulteri	2	0	2.0
Pinus attenuata	2	0	18.0
Pinus sabiniana	1	0	0
Pinus contorta	1	0	4.0
Totals	33	2.2	5.4
Arceuthobium occidentale			
Pinus sabiniana	17	2.9	7.2
Pinus muricata	5	3.8	7.1
Pinus contorta	2	3.3	6.5
Pinus radiata	2	10.0	0
Pinus coulteri	2	2.0	2.0
Pinus ponderosa	2	0	4.0
Totals	30	3.3	6.0

References

Hawksworth, Frank G., and Delbert Wiens. 1970. New taxa and nomenclatural changes in *Arceuthobium* (Viscaceae). Brittonia 22:265-269.

Hawksworth, Frank G., and Delbert Wiens. 1972. Biology and classification of dwarf mistletoes (*Arceuthobium*). U.S. Dep. Agric., Agric. Handb. 401, 234 p.

Kuijt, Job. 1970. A systematic study of branching patterns in dwarf mistletoes (*Arceuthobium*). Memoirs Torrey Bot. Club 22 (4):1-38.